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RATE OF GROWTH IN A SELECTIVELY LOGGED STAND IN THE BOTTOMLAND HARDWOODS

By

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* - This series of publications releases data gathered in connection with investigations being carried on at the Southern Station. The information contained in them is subject to correction or amplification following further investigation. - Editor

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IN

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The bottomland hardwood forests of the Mississippi River Delta region cover an area of approximately fifteen million acres mostly in Arkansas, Louisiana, and Mississipppi, and a relatively small area in Missouri and Tennessee. It is estimated that ten percent of this area is occupied by virgin old-growth forests, and that an additional thirty percent is occupied by second-growth stands and partly-cut old-growth stands having sufficient volume of sawtimber per acre for commercial cutting. The forests of this region supply at present twenty-five percent or more of the hardwood lumber cut in the United States.

Selective logging as a means of perpetuating or prolonging the life of a sawmill operation is not as yet extensively practiced in the bottomland hardwood forests of the Delta, and little definite information is available as to the rate of growth whch may be expected under this system of cutting. A few operators have in the last 5 or more years adopted a policy of partially cutting their hardwood timber stands with the purpose of leaving sufficient growing stock to provide for future cuttings of high-grade material. By a careful selection of trees to be cut in uneven-aged virgin forests which are commonly found in this region, the loss through death and decay can be greatly reduced. By removing the slow-growing, old, decadent trees the rate of growth of the younger, thrifty trees is increased by freeing them from the shade and competition of these older associates.

This study represents the findings on but one selectively logged virgin stand of the red gum ridge-oak type in Central Louisiana. Further studies in this and other types for both old-growth and second-growth bottomland hardwoods will be necessary before the full possibilities of selective logging in the Mississippi Delta region can be evaluated.

The stand-growth figures presented in this paper were obtained form a study made on a plot established in September 1933 in St. Landry Parish, La. The

plot was rectangular in shape, 8 chains by 15 chains on a side, with an area of 12 acres. It was in a stand of timber of the red gum ridge-oak type which, previous to the cutting made in the winter of 1925-26, was practically in the virgin condition and contained many mature and overmature trees. An occasional old stump and released growth on some of the standing trees indicated that a few trees had been cut from the area about 1916. This stand may be taken as representative of areas of similar type and condition in the Delta.

The cutting made during the winter of 1925-26 actually consisted of two operations. The first was planned with the intention of removing only the obviously overmature and deteriorating trees. The second was necessitated by a storm immediately following the first cut and was for the purpose of salvaging timber blown down or damaged. Not only the planned cutting, but also the storm and subsequent salvage cutting contributed to the opening up of the stand and improved growthing conditions for the trees which remained. Obviously, however, such a release was not as effective in promoting growth for the stand as a whole as a cutting carefully worked out for that purpose would have been. As it was, the best possible spacing was not attained, and a number of trees were left which undoubtedly should have been cut, while some that were blown down would have made more desirable growing stock than those which remained.

It is not expected that the maximum volume-growth possibilities will be attained within 8 years after the first cut, nor even within the first cutting cycle, in a stand originally stocked largely with mature and overmature trees. A certain amount of time is required to build up the growing stock to the desired condition.

It should be noted that the period of growth following cutting came soon after the drought or 1924, which resulted in considerable loss through mortality for several years following its occurrence. The net growth is therefore probably low compared to what might normally have been expected.

It follows, then, that the growth during the 8 years between the logging and the date of this study does not cover the full possibilities of a stand handled over a long period of time under a system of carefully planned selective cutting.

Data secured

The following data were recorded for each tree over 9 inches in diameter on the plot: Species, diameter at breast height ($4\frac{1}{2}$ feet above ground), crown form, present merchantable length, estimated merchantable length at date of the cutting, and diameter growth at breast height for the 8 years following the cutting and for the 8 years preceding the cutting (obtained from increment borings). In addition, the present merchantable length of the tree was divided up into log lengths, and the length, grade, and estimated diameter at the small end recorded for each log. Note was made of any change in log grade which was believed to have occurred since the date of the cutting.

The number of trees removed in logging was determined from the stumps on the area, and their diameters and merchantable lengths estimated from the size of the stump, and from the position and size of the tops, which were usually to be found where they had fallen when the trees were cut. The volumes of felled trees were then computed from volume tables.

All dead trees which by their condition indicated that they had died since the date of logging were tallied by diameter and merchantable length and their volumes obtained from volume tables.

Volume computations

The volume in each dead tree as figured above consists of its volume at the date of the cutting plus whatever growth took place in the tree between this date and its death. The amount of the growth (estimated as 27 board feet per acre) was deducted from the volume of each dead tree. Hence the figure used for volume of each tree which died represents its volume at the date of the cutting.

Volumes of trees standing at the time of plot establishment (1933) were computed from the tally of logs in the standing trees and a log-scale table. The volume in these trees at date of the cutting was computed by making a reduction in the present diameter of each log equal to 0.8 of the diametric growth of the tree since the cutting as measured by increment borings at breast height. This factor of 0.8 was used because the diameter inside the bark at the top of the first log is approximately 0.8 of the diameter at breast height for trees of the species involved in this study.

Table 1 shows, on a per-acre basis, the stand volume in 1933, the volume at time of cutting in trees which lived through to 1933, gross volume growth for the 8-year period since cutting, the volume loss through mortality, the net volume increase for the 8-year period, and the net volume growth per year. Volume now and volume at release are given by log grades.

Log grades

Logs falling in grades 1 and 2 are those of the quality which would ordinarily be taken in lumber-mill log purchases on the open market. Logs of grade 1 should cut 60 percent or more of #1 common or better lumber. Log of grade 2 should cut 35 percent or more of #1 common or better lumber.

In general, the minimum log diameters for logs of grade 1 and 2 are 18 inches and 14 inches, respectively; however, exceptionally good logs not more than 2 inches below these limits are permitted in each grade. For ash, the minimum for grade 1 is 14 inches and for grade 2 is 12 inches.

Grade 3 includes logs of high quality but too small or having too much sweep to be classed as grade 2. Logs of this grade are particularly suitable for the production of staves and small dimension. The minimum diameter for this grade is 9 inches.

Grade 4 includes logs falling below the requirements of the previous grades but not less than 10 inches in diameter and suitable for the production of ties, rough structural material, and box and crate lumber.

Table 1. - Summary of plot volume[1] and growth data

Item	Board feet per acre				
	In log grade 1	In log grade 2	In log grade 3	In log grade 4	In all grades
Volume now (1933)	1,030	3,731	285	3,073	8,119
Volume at time of cutting, 1925-26 (in trees surviving until 1933)	826	2,915	296	2,258	6,295
Volume growth for 8-year period since time of cutting	204	816	-11	815	1,824
Loss through mortality (volume in 1925 of trees which died during 8-year period)	-	-	-	-	424
Net gain in volume for 8-year period	-	-	-	-	1,400
Net gain in volume per year	-	-	-	-	175
Volume logged in 1925-26	-	-	-	-	5,777

[1]Volumes are by Scribner log scale.

Table 2 gives the average board-foot volume per acre by log grades in trees 28 inches and over in diameter and in trees under 28 inches in diameter. A comparison of the figures for the two groups shows that in trees 28 inches and over, 74 percent of the volume is in log grades 1 and 2, while in trees under 28 inches in diameter only 44 percent of the volume is in these two upper grades. This shows the advantage of confining the cut to the larger diameters and leaving the smaller trees to increase in quality and volume.

Table 2. - Average per acre by log grades in 1933

Item	Number of board feet				
	In log grade 1	In log grade 2	In log grade 3	In log grade 4	In all grades
Volume in trees 28 inches and over in diameter	902	2,018	-	1,047	3,967
Volume in trees under 28 inches in diameter	128	1,713	285	2,026	4,152
Total volume	1,030	3,731	285	3,073	8,119

Table 3 presents a stand table of all trees on the plot which had a board-foot volume at time of measurement in 1933. This table also shows by diameter classes the number of trees logged and the number of trees which died between logging and the date of plot establishment.

Table 3 - Showing number of trees by diameter classes for the 12 acres[1]

Diameter class	Trees logged (1925-26)	Mortality (1926-33)	Trees having board-foot volume at date of measurement (1933)
Inches	---------- Number of trees ----------		
12-15	-	2	62
16-19	-	2	52
20-23	1	5	55
24-27	2	3	38
28-31	7	1	32
32-35	17	1	14
36-39	11	-	4
40-43	4	-	1
44-47	8	-	1
48-51	1	-	-
Total	51	14	259
Average per acre	4.2	1.2	21.6

[1]Culls and trees too small to make sawlogs are not included.

Volume growth

Table 1 shows that an average gross increase in volume of 1,824 board feet per acre took place in trees living through from the date of logging (1925-26) until the date of measurement, September 1933. Of this, 1,598 board feet was the increase in volume of trees which were of sawlog size at the time of logging, and 226 board feet are accounted for by trees which grew into sawlog size during this 8-year period. An average loss of 424 board feet per acre occurred during this 8-year preiod in trees which died, making the net increase in volume 1,400 board feet per acre for the 8 years or 175 board feet per acre per year.

The volume assigned to standing trees in this study were intended to include all material which might conceivably be used for lumber, staves, ties, etc. It is recognized that few if any lumber mills at the present time would utilize for sawtimber the full volume shown for the plot. Under a system of selective logging where the cut is made entirely from trees of the larger diameters, it is only the utilization in such trees with which we need be concerned. Utilization varies considerably from one operation to another. It is estimated that 80 percent or more of the volume in trees of the larger diameters will be used by the average lumber operator, while some will undoubtedly use practically the entire volume. For an operation where only 80 percent of the volume is utilized, the available growth per year would be 140 board feet per acre.

Table 4 shows for each species the average board-foot volume growth per tree by diameter groups. The growth shown in the 9 to 14-inch class is comparatively low due to the fact that many trees in this class did not reach the minimum size on which board-foot volume is figured.

Table 4. -- Eight-year volume growth (1926-1933) per tree by species and diameter group[1/]

Species	9 inches to 14 inches		15 inches to 20 inches		21 inches to 26 inches		27 inches to 32 inches		33 inches up	
	Number of trees	Average growth per tree	Number of trees	Average growth per tree	Number of trees	Average growth per tree	Number of trees	Average growth per tree	Number of trees	Average growth per tree
		Board feet		Board feet		Board feet		Board feet		Board feet
Cow oak, Quercus prinus	33	25	17	48	31	86	25	91	5	125
Cherrybark oak, Quercus rubra var. pagodaefolia and var. leucophylla	29	65	9	196	6	211	1	261	2	201
Water oak, Quercus nigra	30	50	27	116	12	163	3	194	-	-
Red gum, Liquidambar styraciflua	12	16	6	32	3	89	4	82	1	51
White elm, Ulmus americana	15	28	9	21	3	21	-	-	-	-
White ash, Fraxinus americana	3	52	1	125	-	-	-	-	-	-
Green ash, Fraxinus pennsylvanica var.lanceolata	5	6	1	32	-	-	-	-	-	-
Nuttall oak, Quercus nuttallii	2	32	1	92	-	-	-	-	-	-
Winged elm, Ulmus alata	3	20	-	-	-	-	-	-	-	-
Black gum, Nyssa sylvatica	7	12	-	-	-	-	1	98	-	-
Red maple, Acer rubrum	3	28	-	-	-	-	-	-	-	-
Honey locust, Gleditsia triacanthos	5	19	-	-	-	-	-	-	-	-
Hackberry, Celtis laevigata	1	13	-	-	-	-	-	-	-	-

1/ Grouping is by size at date of cutting, 1925-26.

Table 5, giving for each species the average diameter growth for the 8-year periods before and following cutting, shows how the various species responded to the opening up of the stand.

Table 5. - Showing average diameter growth by species for 8-year period before and after the cutting

Species	Number of trees	8-year Diameter growth since cutting (1926-1933)	8-year Diameter growth before cutting (1918-1925)
		Inches	
Cow oak	124	1.71	1.35
Cherrybark oak	56	3.28	1.70
Water oak	95	2.67	1.81
Red gum	29	1.86	1.57
White elm	34	1.38	1.02
Winged elm	6	1.90	1.17
White ash	10	2.50	1.82
Green ash	13	1.35[1]	1.43
Black gum	11	1.83	1.43
Nuttall oak	5	2.86	1.40
Honey locust	8	1.81	1.78
Hackberry	2	1.35	1.30
Red maple	8	1.59	1.48

[1] The poor showing made by green ash after cutting was probably due to the fact that nearly all of the trees of this species were semi-suppressed and werein groups not opened up by the cutting.

Summary

In 1933, growth was studied on an area of 12 acres in a bottomland hardwood stand selectively logged in the winter of 1925-26. At the time of logging, 5,777 board feet per acre were removed in 51 trees, 46 of which were 30 inches or more in diameter. After the logging, a stand of 6,719 board feet per acre remained. Of this, 6,295 board feet were in trees which survived through tc 1933, while 424 board feet were in trees which died between 1925 and 1933.

The trees which survived had a volume in 1933 of 8,119 board feet per acre. Considering only the trees that were living in 1933, this represents a growth of 1,824 board feet. Since mortality removed from the stand 424 board feet that had been present in 1926, the net growth during the 8-year period (1926-1933) was 1,400 board feet per acre or 175 board feet per acre per year.

This rate of growth was attained during the first 8 years following a cutting in which the selection of trees to be removed could have been greatly improved and during a period of abnormally high mortality due to drought. It is not to be taken as representative of the full possibilities of growth in selectively-cut bottomland stands in the Mississippi Delta.

This study showed that at the time of measurement 74 percent of the volume of trees 28 inches and over in diameter was in logs of high quality, while in trees under 28 inches in diameter only 44 percent of the volume was in logs of similar high quality. Under a system of selective cutting taking only the trees from the larger diameter classes, a large proportion of high-grade logs is obtained, while the smaller trees are left to increase both in size and quality.